

REPORT

TO THE

ANDERSON--COTTONWOOD

IRRIGATION DISTRICT

DISCUSSING THE COST

OF ITS

PROPOSED IRRIGATION SYSTEM

BY

H. H. HENDERSON

MEM. AM. SOC. C. E.

ERRATUM.—The last paragraph under head "Pumping Plants," page 10, should read:

"It is estimated that the cost of pumping to the plains east of Churn Creek Bottom will not exceed \$2.70 per acre," etc.

Stockton, Cal., Jan. 7th, 1915.

Anderson-Cottonwood Irrigation District

Anderson, California.

The following is my final report relative to the cost of your proposed irrigation system. There should be, however, before any contracts for work are let, subdivisional reports covering the project by sections. These subdivisions to be such as to make the cost of construction economical, taking into consideration the time necessary to complete the whole work.

Description of Main Canal and Laterals.

It is hardly necessary, at this time, to describe the route of the proposed canal inasmuch as it has been discussed before, many times, therefore, I will but briefly state its general location.

The head of the canal will be at the bank of a channel known as the "Wheel Ditch". This ditch is situated just north of the town of Redding. It takes water out of the main channel of the River and leads westward around an island of some five acres in extent, returning its flow to the River at the lower end of the island. An undershot water-wheel has for many years past been located in this channel. The function of this wheel is to pump water upon the land lying adjacent to this island and extending northerly to a point just above the new concrete bridge spanning the Sacramento River.

The water, after being taken from the Wheel Ditch is passed, through a concrete lined tunnel. This tunnel is to be two thousand four hundred eighty (2480) feet in length and ten (10) feet in diameter.

At the lower portal of the tunnel the water is conveyed through an open channel for some four thousand (4,000) feet. Approximately sixteen hundred (1600) feet of this channel was formerly used to convey water for power purposes. The water is to be diverted from this channel by means of a weir. This weir is to be so constructed as to provide for winter drainage and the flushing of the canal above it.

The canal then continues along the route, as delineated upon the several topographical sheets, hereinbefore presented. By observing these sheets it will be seen that the route of the canal passes

just west of the County Hospital and extends thence in a south-westerly direction crossing the Southern Pacific Railroad and then continues southerly along the contour of the Valley west of the town of Anderson to Panorama Point. The main canal does not again cross the Southern Pacific Railroad until it has reached the land lying on the southerly side of Cottonwood Creek.

Below Panorama Point the canal turns westward and crosses Cottonwood Creek at a point approximately one mile west of the Becker Ranch. This ranch is situated almost directly opposite to the confluence of the forks of Cottonwood Creek.

The water is to be conveyed across Cottonwood Creek by means of a concrete syphon and from there through an open canal to a point on the Owens place where the same has an outlet into Cottonwood Creek for the discharge of surplus waters.

A branch is to be taken out of the main canal upon the Frank tract, which tract is situated approximately four miles below the head of the canal. This has been termed the "Churn Creek Main", and runs in a south-easterly direction and will supply water to the adjacent territory as well as being the source of supply for the Churn Creek Bottom.

The water is conveyed from the above branch at a point situated approximately one thousand (1000) feet south-easterly from Mr. Frank's residence, through a concrete and cast-iron syphon, to the main branch on Churn Creek Bottom.

The main branch is again subdivided into four laterals. Three of these laterals flow southerly along the ridges of the Churn Creek Bottom. They are provided with spillways at the lower end of each branch.

The fourth branch is taken out of the main lateral, on the Martin place, and flows south-easterly to a point situated about three-quarters of a mile south-easterly from the Harris residence. At this point it is proposed to lift the water by means of a pump to a lateral supplying that part of the district situated upon the Stillwater Plains.

Main Canal Laterals situated West of the Sacramento River.

Lateral No. 1 is taken out of the Churn Creek branch as hereinbefore described, and runs for a distance of approximately one mile in a southerly direction.

Lateral No. 2 takes out along the northern boundary of the White property and is conveyed and runs easterly for a distance of approximately one mile.

Lateral No 3 takes out of the canal just below Chinese Gulch and supplies the territory west of Clear Creek.

Lateral No. 4 takes out near the northern boundary of the Kleinberg property and is approximately two miles in length, covering the Potter and Fickas property.

Lateral No. 5 takes out near the southern boundary of the Hartong property and runs easterly for a distance of approximately one mile.

Lateral No. 6 takes out along the southern boundary of the Elmore property and runs easterly for a distance of approximately two miles.

Lateral No. 7 takes out near the southern boundary of the Miller Addition and runs easterly and southerly for a distance of about three miles. This lateral is again subdivided and two laterals are taken out whose lengths are approximately one and one-half mile each and are located so as to supply all of the smaller subdivisions lying east of the town of Anderson.

Lateral No. 8 is taken out of the main canal near the left bank of Anderson Creek and flows down for some distance along this Creek where it is subdivided into two main laterals which are located along the high ridge which nearly parallels the course of the Sacramento River. These laterals extend as far south and serve a part of the C. C. Moore ranch. The excess water from lateral No. 7 will be discharged in part into lateral No. 8.

Lateral No. 9 leaves the main canal just south of the race track which is situated near the town of Anderson, and extends for a distance of some two and one-half miles along the high portion of the Bench land.

Lateral No. 10 takes out of the main canal on the Whittier property, in the north-west quarter of Section 25, Township 30 North, Range 4 West. This lateral is approximately two and one-half miles in length, and will discharge its excess waters into the northern branch of lateral No. 8.

Lateral No. 11 will leave the main canal on the Whittier property, of Section 31, Township 30 North Range 3 West. This lateral is approximately two miles in length, and will convey the water to the Owens property and other property situated upon the Bench line.

Lateral No. 12 leaves the main canal at Panorama Point and flows easterly, supplying a part of the Bench lands and the upper part of the C. C. Moore ranch. This lateral, like all of the others, is provided with a spillway which leads into a gulch leading into the Sacramento River.

Lateral No. 13 is situated also at Panorama Point and will supply the Hencratt and adjacent property.

Lateral No. 14 is situated just around from Panorama Point and will supply the property paralleling the main canal and lying north of the Railroad track at that point.

Lateral No. 15 takes out of Section 1, Township 29 North, Range 4 West, and supplies the several subdivisions of the western part of said Section 1.

Lateral No. 16 takes out on the Minney property in Section 2, Township 29 North, Range 4 West, and flows southerly for a distance of approximately one and one-half mile. This lateral will serve the smaller subdivisions in the vicinity of the town of Cottonwood.

Lateral No. 17 is taken out of the main canal in Section 10, Township 29 North, Range 4 West, and will supply the Gray and Smith property.

Lateral No. 18 is taken out on the western boundary of the Barry place and is approximately three-quarters of a mile in length.

Lateral No. 19 will take out on the western boundary of Section 13, Township 29 North, Range 4 West, and will be provided with a drainage into Cottonwood Creek. This lateral will also serve a part of the Barry Ranch.

Lateral No. 20 will take out of the main canal on the western boundary of Section 18, Township 29 North, Range 3 West, and is approximately two and one-half miles in length. It will supply the Owens ranch.

Main Canal Side Gates and Waterways.

Side gates and waterways have been provided along the main canal for each of the several properties over which it passes, many of which do not require a lateral and therefore have not been designated as such.

All laterals are provided with side gates for each property. This is also true of the several laterals situated on the Churn Creek side.

Sacramento River Diversion Dam.

A concrete dam of the flash-board type will be used for making the diversion during low flow of the Sacramento River. This dam will be situated at the head of the Wheel Ditch and will be approximately five hundred feet in length. The upper five feet of the structure is made up of steel members and during the flood period they are to be folded back into the bents of the dam structure.

The back of the dam slopes up stream and is so designed as to prevent the catching of drift. The height of these bents are approximately three feet above the low water and it will thus be seen that a slight rise in the River entirely submerges the structure and protects it from debris.

Wheel Ditch Irrigation System.

In considering the diversion as above outlined, it became necessary to provide for a new supply of water for the property of Mr. Desilhorst.

The weir situated at the intake of the canal will entirely destroy the grade of the Wheel Ditch. This head is now being used for the pumping of irrigation water upon the lands of Mr. Desilhorst. I have considered the installation of a turbine directly connected to a centrifugal pump as a substitute for the wheel which will be destroyed by this construction. The turbine and pump will be situated in the weir at the inlet to the tunnel. The water for Desilhorst's irrigation will be conveyed into the same ditch into which the wheel discharges and equal in quantity.

Water Supply for Irrigation System.

It is not necessary in this report to discuss the water supply further than to say that the discharge of the Sacramento River, during its lowest period in 1913, was at least five thousand second feet.

This question, however, is one of paramount importance in almost every other irrigation system that has been planned, or built, in the State of California, and is necessarily so on account of the low discharges of the streams during the summer months. The San Joaquin River, which is the largest River in the State, other than the Sacramento River, diminishes to a summer flow of approximately six hundred second feet. There are, however, from this river approximately four hundred thousand (400,000) acres under irrigation.

Duty of Water.

In considering the size of the canal, for this project, a duty of water was taken at one hundred (100) acres to the second foot, and to that amount has been added approximately ten per cent for canal losses. From measurements made by myself, and others, it has been shown that one hundred sixty (160) acres are served in many places from one second foot of water.

Capacity of Main Canal and Laterals.

These capacities are based upon requirements according to acreage served. In planning the main canal the upper section was designed to carry a minimum of three hundred sixty-five second feet.

This section lies between the Head Works and Olney Creek, at which point the section is reduced to three hundred second feet capacity.

This section continues to Spring Gulch where the

capacity of the canal was reduced to two hundred seventy-five second feet.

This section was carried to Anderson Creek where it was reduced to a capacity of two hundred twenty-five second feet.

From Anderson Creek this section was carried to a gulch at Panorama Point, at which point the canal's carrying capacity was reduced to one hundred seventy-five second feet.

This section was then carried to Ludwig Gulch where the canal's capacity again reduced to one hundred second feet.

This capacity was carried to the bank of Cottonwood Creek where the section was reduced to eighty-seven second feet.

This section was then carried to Hieber Creek where it was reduced to fifty second feet and remaining section of the canal continued in that size until it reached its extreme lower end where it spills into Cottonwood Creek.

All laterals have been designed with the carrying capacity of at least thirty-five second feet. Laterals number eight and twelve are each designed for fifty second feet.

Storm Water Drainage and By-Passes.

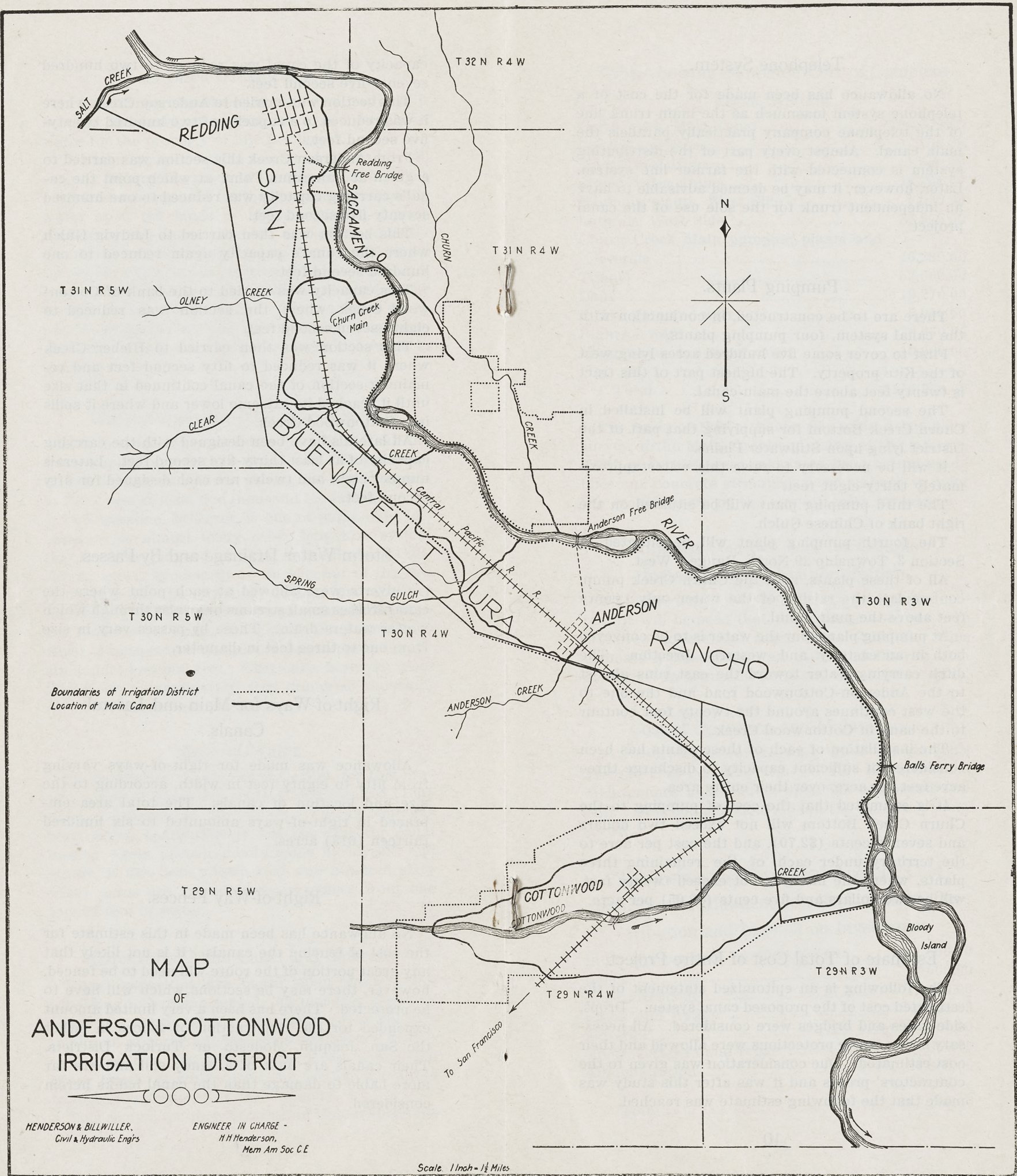
Culverts were allowed at each point where the canal crosses small streams or swales through which winter waters drain. These by-passes vary in size from one to three feet in diameter.

Right-of-Ways for Main and Lateral Canals.

Allowance was made for right-of-ways varying from fifty to eighty feet in width, according to the size and location of canals. The total area embraced in right-of-ways amounted to six hundred thirteen (613) acres.

Right-of-Way Fences.

No allowance has been made in this estimate for the cost of fencing the canals. It is not likely that any great portion of the route will need to be fenced, however, there may be sections which will have to be protected. There has been a very limited amount expended for the construction of fences in either the San Joaquin, Modesto or Turlock Districts. Their canals are built of a sandy soil and are far more liable to damage than the canal banks herein considered.



MAP
OF
ANDERSON-COTTONWOOD
IRRIGATION DISTRICT

HENDERSON & BILLWILLER,
Civil & Hydraulic Engrs

ENGINEER IN CHARGE -
H H Henderson,
Mem Am Soc C E

Scale 1 inch = 1 1/2 Miles

Telephone System.

No allowance has been made for the cost of a telephone system inasmuch as the main trunk line of the telephone company practically parallels the main canal. Almost every part of the distributing system is connected with the farmer line system. Later, however, it may be deemed advisable to have an independent trunk for the sole use of the canal project.

Pumping Plants.

There are to be constructed, in conjunction with the canal system, four pumping plants.

First to cover some five hundred acres lying west of the Kite property. The highest part of this tract is twenty feet above the main canal.

The second pumping plant will be installed in Churn Creek Bottom for supplying that part of the District lying upon Stillwater Plains.

It will be necessary to raise this water approximately thirty-eight feet.

The third pumping plant will be situated on the right bank of Chinese Gulch.

The fourth pumping plant will be situated in Section 3, Township 29 North, Range 4 West.

All of these plants, save the Churn Creek pump, contemplate the raising of the water only twenty feet above the main canal.

At pumping plant four the water is to be conveyed both in an easterly and westerly direction. The ditch carrying water toward the east runs almost to the Anderson-Cottonwood road and the one to the west continues around the twenty foot contour to the bank of Cottonwood Creek.

The installation of each of these plants has been considered of sufficient capacity to discharge three acre feet per acre, over their entire area.

It is estimated that the cost of pumping to the Churn Creek Bottom will not exceed two dollars and seventy cents (\$2.70), and the cost per acre to the territory under each of the remaining three plants, where the lift does not exceed twenty feet, will be two dollars and five cents (\$2.05) per acre.

Estimate of Total Cost of Entire Project.

The following is an epitomized statement of the estimated cost of the proposed canal system. Drops, side gates and bridges were considered. All necessary storm water protections were allowed and their cost estimated. Due consideration was given to the contractors' profits and it was after this study was made that the following estimate was reached.

Table showing estimated Cost of Complete
Canal System,

Earth work, Main Canal	\$90,619.00
Concrete syphons	41,983.00
Main Canal drops	1,500.00
Storm water drains	16,558.00
Pumping plants, West Side	8,520.00
Laterals, West Side	37,570.00
Churn Creek Main pumping plants and laterals	46,280.00
Tunnel	52,000.00
Dam	19,270.00
Intake gate and weir	5,000.00
Right-of-ways	30,650.00
Engineering and supervision	10,000.00
Total	\$359,950.00

The basis of this estimate was upon a complete survey of the Main Canal and many of the laterals. Earth quantities were calculated from actual grade lines and concrete structures were planned to meet the requirements of the several creek crossings.

Estimated Cost per Acre for Complete
Installation of Irrigation System.

From the above estimated cost of the entire system, it will be seen that the average cost per acre is eleven dollars and seven cents (\$11.07). This estimate is based upon an estimated District area of thirty-two thousand five hundred (32,500) acres.

Cost of Operation and Maintenance.

For the purpose of showing what the probable average cost per acre will be for the operation, maintenance and interest upon the completed system, I have compiled and submit the following table, to-wit:

Table showing Estimated Average Cost
per Acre for Maintenance, Replacement, Dis-
tribution and Interest on Investment.

Interest 6 per cent on \$360,000.00	\$21,600.00
Labor	4,000.00
Superintendent	1,800.00
Stock and wagon	5,150.00
Material	500.00
Tools, scrapers and repair	350.00
Administration	4,860.00
Total	\$38,260.00

The above cost items are taken from experience in the actual handling of a Canal System and are ample in every respect. This, of course, would not apply to interest or administration. The interest item would depend upon the bond issue and the cost of administration was composed of the following monthly items to-wit:

Estimated Cost of Administration.

Tax Collector, per month	\$50.00
Assessor, per month	75.00
Directors (5), per month	50.00
Office Rent, per month	25.00
Secretary, per month	125.00
Attorney, per month	50.00
Treasurer, per month	30.00
<hr/>	
Total cost, per month	\$405.00
Cost, per year	\$4,860.00

Estimated Average Cost per Acre for Maintenance, Interest, Replacement, and Distribution

From the above estimate of actual cost for operation, it will be seen that the average annual cost per acre will be One dollar and twenty cents (\$1.20) per acre, based upon an acreage of Thirty-two thousand five hundred (32,500) acres.

Drainage System.

No consideration has been given to a drainage system as it has been ascertained by surveys that only a few places will ever feel the need of such construction. The great slope of the Valley toward the river has eliminated this usual expense.

This again is an answer to the reasons for low unit cost.

Respectfully submitted,

H. H. HENDERSON, M. A. S. C. E.

Engineer in Charge.

REPORT

TO THE

ANDERSON--COTTONWOOD

IRRIGATION DISTRICT

DISCUSSING THE REPORT

OF

H. H. HENDERSON

Relative to the Construction Cost of its

Proposed Irrigation System

BY

C. D. MARTIN

MEM. AM. SOC. C. E.

Stockton, Cal., Jan. 8th, 1915.

To the Honorable Board of Directors of the Anderson-Cottonwood Irrigation District.

In compliance with your expressed desires I have made an examination of your proposed irrigation system.

On the 23rd and 24th of November, 1914, in company with Mr. H. H. Henderson, I examined the general route of the Main Canal and casually the country which the irrigation system was to supply. Due consideration was given to the various soils which would be encountered during construction.

Subsequent to my inspection of your project, I studied and discussed with Mr. Henderson every feature of the canal location, design of structures, necessary water supply, general distribution, cost of system and operation.

Water Supply and Duty.

Owing to the great flow of the Sacramento River, during its lowest stages, the question of supply is not at issue and requires no discussion.

From my personal experience of irrigation in Central California, I feel that the estimate made by Mr. Henderson, of the quantity of water necessary to irrigate your district, is sufficient. The duty of one hundred sixty acres to each second foot of water is a fair average of the duty of water in the San Joaquin Valley. Your project is located in a region where the average rainfall is nearly three times that of the San Joaquin Valley.

I would say that the loss allowed for seepage and evaporation amounting to ten per cent is adequate.

Distribution System.

The topographical features of your district are such that the Main Canal serves as a distributing system. Thus reducing the lateral system very materially, giving a low overage rate of cost per acre.

The system in its entirety does not offer any difficult engineering problem.

Head Works.

From the data gathered, by your survey, I would say that the dam will have a foundation of rock of sufficient firmness. The greater portion of the river

bed at the dam site is free from a covering of gravel and samples of this bed rock have been taken.

Inasmuch as the river is shallow at your dam site the cost of unwatering will be small.

Estimated Cost of Project.

In estimating the cost, I have checked all of the data with Mr. Henderson, and have given due consideration to all features of construction and consider the amount stated in his report, viz: \$359,950.00 adequate to build the system.

Fencing and Telephone.

The items of fencing and telephone have not been included in estimate of cost, but were considered as stated in Mr. Henderson's report, in which I concur.

Maintenance and Operation.

I have carefully considered Mr. Henderson's estimate of the cost of maintenance and operation, and I find that the allowances therein made are liberal and will prove adequate, for all needs.

In conclusion, I will state that I see no reason why your proposed system should not be built and maintained within the amounts stated in Mr. Henderson's report. There are no hazardous undertakings and the system should be built and maintained for the lowest unit cost of any in this State.

Respectfully submitted,

CHAS. D. MARTIN,
Consulting Engineer.

W

the cost of the work will be paid by the owner of the property. The work will be done by the owner of the property. The work will be done by the owner of the property.

of Project

I have checked all of the work and have given the contractor the necessary instructions and have given him the necessary instructions and have given him the necessary instructions.

and Telephone

The work will be done by the owner of the property. The work will be done by the owner of the property. The work will be done by the owner of the property.



News Print
Anderson
California

14000
7500
7500
7500
7500
7500
7500